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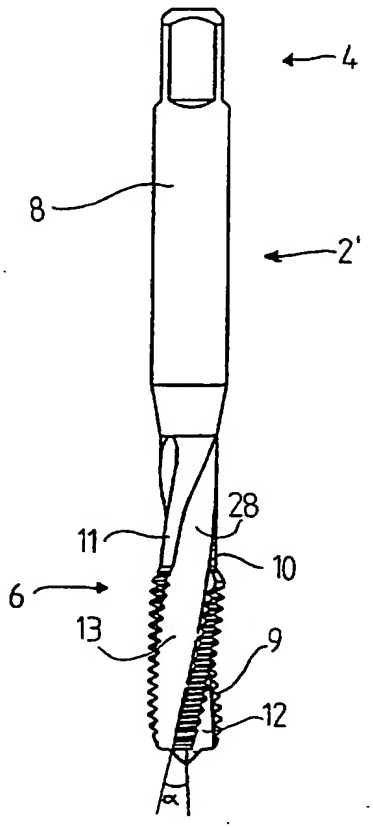
(54) Title: A THREAD CUTTING TAP AND A METHOD OF ITS MANUFACTURE



(57) Abstract: A thread cutting tap having an elongated body, comprises at a first end a connector portion (4) adapted to be connected to a tool and at a second end a threaded portion (6) for cutting out a thread in a wall of an opening into which said threaded portion is to be introduced, said threaded portion (6) being provided with at least two cutting edges (15) in the circumferential direction of said body, each of said cutting edges (15) being an integral peripheral part of a flank portion (10) extending substantially radially from the longitudinal extension of said body, said flank portions (10) defining thembetween a chip removal flute (12, 13, 14) in the longitudinal extension of said body for removal of chips cut from said wall, wherein at least one of said flank portions (10) having a side-wall (16, 18, 20) is divided into a pair of elongated concave surfaces separated by an elongated ridge (22) constituting a chip-breaking member (22). According to the invention, said chip removal flutes (12, 13, 14) are at least partly helically shaped. The invention also relates to a method for manufacturing such a thread cutting tap.

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Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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A thread cutting tap and a method of its manufacture

TECHNICAL BACKGROUND OF THE INVENTION

The present invention relates to a thread cutting tap having an elongated body, comprising at a first end a connector portion adapted to be connected to a tool and at a second end a threaded portion for cutting out a thread in a wall of an opening into which said threaded portion is to be introduced, said threaded portion being provided with at least two cutting edges in the circumferential direction of said body, each of said cutting edges being an integral peripheral part of a flank portion extending substantially radially from the longitudinal extension of said body, said flank portions defining thembetween a chip removal flute in the longitudinal extension of said body for removal of chips cut from said wall, wherein at least one of said flank portions having a side-wall is provided with a chip-breaking member.

It also relates to a method of manufacturing such a thread cutting tap.

A thread cutting tap of this kind is known from US-A-2 145 819. The therein described cutting tap has straight chip removal flutes. Such flutes are disadvantageous, since the transportation of chips is poor, risking to cause accumulation of chips in the flutes. It also suffers from the drawback that it can only be used at relatively low cutting speeds.

Other thread cutting taps are known from JP-A-61136726 and JP-A-61136725, according to which the chip-breaking member is an indentation of a surface of the flank portion. The chip-breaking member in the form of an indentation is however disadvantageous, because it is only applicable to straight flute taps, as machining of the flank portion for achieving the chip-breaking member is complicated. The document also only relates to thread cutting taps of larger diameters, as there must be space both for introduction of a lubricant and transportation of the chips through a central opening.

Another thread cutting tap provided with chip-breaking members is known from SU-A-1 039 661. The chip-breaking members described in that document are not arranged on a surface of the flank portions.

SUMMARY OF THE INVENTION

It is therefore the object of the invention to provide a thread cutting tap, having improved chip handling properties.

This object has been achieved by a thread-cutting tap the initially defined kind, wherein said chip removal flutes are at least partly helically shaped.

It has also been achieved by a method of the initially defined kind, including forming said chip removal flutes to an at least partly helical shape.

Hereby is achieved a thread cutting tap which can be used at high cutting speeds without entangling or accumulation of chips.

Suitably, the elongated ridge is an edge formed by the immediate interconnection of said concave surfaces. Hereby, a sharp and well-defined chip-breaking member is achieved, which allows for a controlled chip-breaking.

Alternatively, the elongated ridge is formed by a convex surface.

Preferably, at least said surface is coated by a friction reducing coating. Hereby, the transport of the chips is improved. Furthermore, the wear resistance is increased.

Suitably said coating contains a nitride. In particular said coating is anyone of TiN, TiCN, TiAlN, TiAlCN and CrN. Hereby, a hard surface is achieved.

Advantageously, said chip removal flutes are helically shaped over substantially their whole length.

Preferably, the angle between the axial extension of the body and the extension of each of said chip removal flutes is 10°-50°, in particular 10°-25°.

Hereby is achieved a thread cutting tap suitable for forming threads in blind holes at high speeds, since the chips will be transported in the chip removal flutes away from the blind hole, i.e. towards the connector portion of the thread cutting tap.

Alternatively, said chip removal flutes are partly straight and partly helically shaped, said helically shaped flutes being arranged closest to the second end.

Suitably the angle between the axial extension of the body and the extension of each of chip removal flutes is 1°-15°.

Hereby is achieved a thread cutting tap suitable for forming threads in through holes at high speeds, since the chips will be transported in the chip removal flutes away from the through hole, i.e away from the thread cutting tap.

DRAWING SUMMARY

Figure 1A illustrates a prior art thread cutting tap provided with a chip-breaking member,

Figure 1B is a bottom view of the thread cutting tap shown in figure 1A,

Figure 2A illustrates a thread cutting tap according to a first embodiment of the invention,

Figure 2B is a bottom view of the thread cutting tap shown in figure 2A,

Figure 3A illustrates a thread cutting tap according to a second embodiment of the invention,

Figure 3B is a bottom view of the thread cutting tap shown in figure 3A, and

Figure 4 illustrates a bottom view of a thread cutting tap provided with an alternative chip-breaking member.

DETAILED DESCRIPTION

Figure 1A is a side elevation of a prior art straight fluted tap 2 comprising an elongated body having a connector portion 4, a threaded portion 6 and an intermediate portion 8. The threaded portion has, in the longitudinal direction of the body, three flanks 9, 10, 11 (cf. Fig. 1B) divided by three straight flutes 12, 13, 14. The peripheral part of the flanks 10 is provided with cutting edges 15. The cutting edges 15 divided by the flutes 12, 13, 14 form together a virtual continuous helical thread. The flute 12 is defined by a side-wall 16 of the flank 9 and a side-wall 17 of the flank 10, the side-wall 17 being interconnected to the side-wall 16. Likewise, the flute 13 is defined by a side-wall 18 of the flank 10 and a side-wall 19 of the flank 11 and the flute 14 is defined by a side-wall 20 of the flank 11 and a side-wall 21 of the flank 9. Furthermore, the side-walls 18 and 19, and the side-walls 20 and 21 are interconnected, respectively.

Each of the side-walls 16, 18 and 20 has an elongated concave surface, whereas each of the side-walls 17, 19 and 21 has a pair of elongated concave surfaces divided by an elongated ridge 22 in the form of an edge.

Straight fluted taps are suitable for forming threads in through holes as well as in blind holes. The chips may be transported in both directions of the longitudinal extension of the flutes. There is however a risk for accumulation of chips in the flutes.

Figure 2A is a side elevation of a helically fluted tap 2' (also called spiral fluted tap). Such a tap is provided with helical flanks 9, 10, 11 having side-walls 16, 17 and 18, 19 and 20, 21, respectively, defining helical flutes 12, 13, 14 (cf. Fig. 2B).

In Figure 2A, the angle between the axial extension and the extension of the helical flute, the so called flute angle, is denoted by α. The flute angle is preferably between 10° and 50°. The best results are however achieved with a flute angle between 10° and 25°.

Also in this embodiment, each of the side-walls 16, 18 and 20 has an elongated concave surface, and each of the side-walls 17, 19 and 21 has a pair of elongated concave surfaces divided by an elongated ridge 22 in the form of an edge.

Helically fluted taps are suitable for forming threads in blind holes, as chips will be transported in the flutes in a direction towards the connector portion, i.e. away from the blind hole.

Figure 3A is a side elevation of an angularly pointed tap 2'' (also called spiral point tap). Such a tap has threaded portion 6 divided into a straight portion 24 and an angular portion 26. The straight portion has straight flanks 9, 10, 11 having between them straight flutes 12, 13, 14, respectively. In the angular portion 26, the flanks 9, 10, 11 and the flutes 12, 13, 14 are formed angularly in relation to the straight flutes, i.e. angularly in relation to the longitudinal extension of the body.

Also in this embodiment, the side-walls 17, 19 and 21 has a pair of elongated concave surfaces divided by an elongated ridge 22 in the form of an edge. Each edge follows the longitudinal extension form of the flanks and the flutes. The edge is thus straight in the straight portion 24 and angular in relation to the longitudinal extension of the body.

Angularly pointed taps are particularly suitable for forming threads in through holes, as chips will be transported in the flutes in a direction away from the tap, away from the through hole. In this embodiment the flute angle is preferably between 1° and 15° for best performance.

The tap of Fig. 3A is also provided with a lumen 27 for supply of a coolant fluid to the hole where a thread is to be formed. Such a fluid may be compressed air or an emulsion of oil and water or oil and air.

In Figure 4 is shown an alternative chip breaking member. Instead of an edge between the concave surfaces, a convex surface forming a ridge 22 is provided for interconnection thereof.

In all the above described embodiments, the surface of the side-walls 16 – 21 defining the flutes 12 - 14 is provided with a coating 28 containing a nitride, such as TiCN, TiN, TiAlN, TiAlCN or CrN. The coating reduces the friction of the surface and also increases the hardness and the wear resistance thereof.

It should be noted that according to the invention, the described coating is not necessary. Tests have however proven that the form of the chips caused by machining by means of thread cutting taps provided with prior art chip breaking members will take quite different forms, depending on whether the surface of the flute is coated or not. Accordingly, chips will be longer, causing risk for entangling in the flutes.

However, the thread cutting tap described in figures 1-4 provided with the chip breaking members according to the invention and having the walls defining the flutes coated by such a friction reducing coating has proven to create chips of such small sizes, that entangling of the chips is prevented.

As is known from US-A-4 708 542, the threads of a tap may be provided with a friction reducing coating for reducing the friction while cutting the threads. However, the chip flutes of that tap are not provided with a coating.

It should also be noted that the taps described in connection with figures 2A, 2B and 4 may be provide with a lumen for supply of a fluid. Furthermore, the number of flanks and flutes, respectively, may be more or less than three.

OPERATION

A piece of metal is provided with a through hole or a blind hole, either by drilling or by moulding. In order to cut threads therein, a thread cutting tap according to the invention and having a general diameter slightly larger than the hole is used. The tap is rotated about its longitudinal axis while applying some pressure thereon, such that it cuts it way into the hole and forms threads. While cutting, chips are cut away from the wall of the piece of metal defining the hole; owing to the chip-breaking member, the chips are small; and the chips are transported away in the at least partly helical chip removal flutes. As a result, the thread cutting tap according to the invention is allowed to be utilised at high cutting speeds.

CLAIMS

1. A thread cutting tap having an elongated body, comprising at a first end a connector portion (4) adapted to be connected to a tool and at a second end a threaded portion (6) for cutting out a thread in a wall of an opening into which said threaded portion is to be introduced, said threaded portion (6) being provided with at least two cutting edges (15) in the circumferential direction of said body, each of said cutting edges (15) being an integral peripheral part of a flank portion (10) extending substantially radially from the longitudinal extension of said body, said flank portions (10) defining thembetween a chip removal flute (12, 13, 14) in the longitudinal extension of said body for removal of chips cut from said wall, wherein at least one of said flank portions (10) having a side-wall (16, 18, 20) is provided with a chip-breaking member (22), **characterised in that** said chip removal flutes (12, 13, 14) are at least partly helically shaped.

2. A thread cutting tap according to claim 1, wherein said side-wall (16, 18, 20) is divided into a pair of elongated concave surfaces separated by an elongated ridge (22) constituting a chip-breaking member (22),

3. A thread cutting tap according to claim 2, wherein the elongated ridge (22) is an edge formed by the immediate interconnection of said concave surfaces.

4. A thread cutting tap according to claim 2, wherein the elongated ridge (22) is formed by a convex surface.

5. A thread cutting tap according to anyone of the preceding claims, wherein said surface is coated by a friction reducing coating (28).

6. A thread cutting tap according to claim 5, wherein said coating contains a nitride.

7. A thread cutting tap according to claim 5 or 6, wherein said coating is anyone of TiCN, TiN, TiAlN, TiAlCN and CrN.

8. A thread cutting tap according to anyone of the preceding claims, wherein said elongated body defines at least one lumen (27) extending from said connector portion to said threaded portion for allowing supply of a fluid to said threaded portion.

9. A thread cutting tap according to anyone of the preceding claims, wherein said chip removal flutes (12, 13, 14) are helically shaped over substantially their whole length.

10. A thread cutting tap according to claim 9, wherein the angle (α) between the axial extension of the body and the extension of each of said chip removal flutes is 10°- 50°, in particular 10°- 25°.

11. A thread cutting tap according to anyone of the preceding claims, wherein said chip removal flutes (12, 13, 14) are partly straight and partly helically shaped, said helically shaped flutes being arranged closest to the second end.

12. A thread cutting tap according to claim 11, wherein the angle (α) between the axial extension of the body and the extension of each of chip removal flutes is 1°- 15°.

13. A method of manufacturing a thread cutting tap including
- selecting an elongated blank having an elongated body with a first and a second end
- forming at least one thread having a cutting edge (15) at its circumferential periphery at an end portion of said blank
- forming at least two chip removal flutes (12, 13, 14) traversing said thread, such that a flank (9, 10, 11) portion having a side-wall is formed between two neighbouring flutes,
- forming in a side-wall of said flank portions at least one chip-breaking member, **characterised by** forming said chip removal flutes to an at least partly helical shape.

14. A method according to claim 13, including forming said chip-breaking member by separating a pair of elongated concave surfaces of a side-wall by an elongated ridge (22),

15. A method according to claim 14, including forming said ridge as an edge.

16. A method according to claim 14, including forming said ridge as a convex surface.

17. A method according to anyone of claims 13 to 16, including coating said surface with a friction reducing coating (28).

18. A method according to claim 17, including coating said surface by a coating containing a nitride.

19. A method according to claim 17 or 18, including coating said surface by a coating containing anyone of TiCN, TiN, TiAlN, TiAlCN and CrN.

20. A method according to anyone of claims 13 to 19, including forming at least one lumen (27) extending from said connector portion to said threaded portion.

21. A thread cutting tap according to anyone of claims 13 to 20, including forming said chip removal flutes (12, 13, 14) to a helical shape over substantially their whole length.

22. A thread cutting tap according to claim 21, including forming said chip removal flutes such, that the angle (α) between the axial extension of the body and the extension of each of said chip removal flutes is 10°-50°, in particular 10°-25°.

23. A thread cutting tap according to anyone of claims 13 to 20, including forming said chip removal flutes (12, 13, 14) to a partly straight and a partly helical shape, said helically shaped flutes being formed closest to the second end.

24. A thread cutting tap according to claim 23, including forming said chip removal flutes such that the angle (α) between the axial extension of the body and the extension of each of chip removal flutes is 1°-15°.

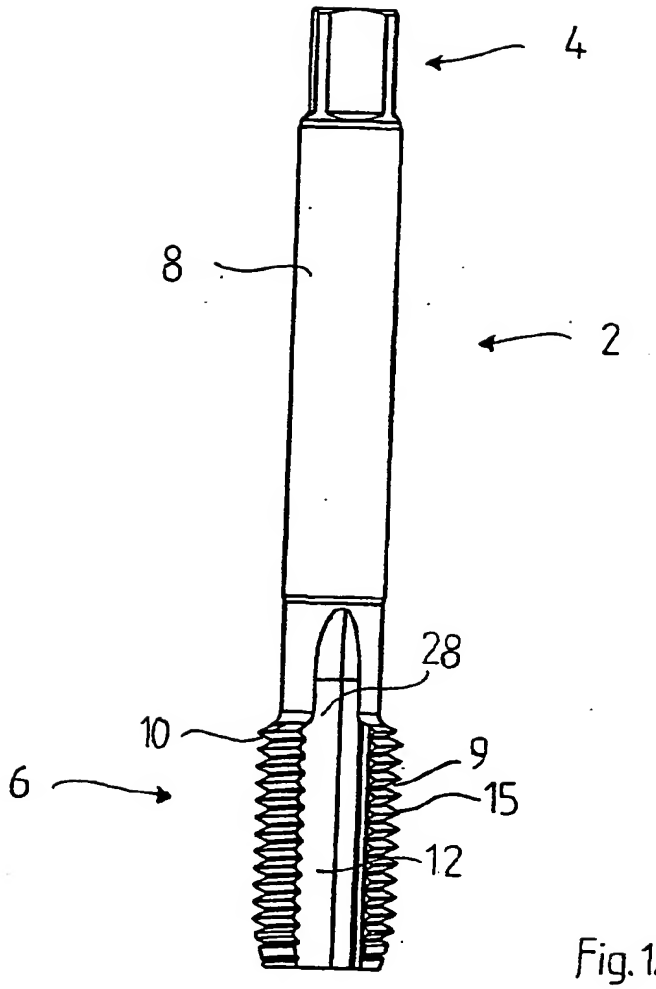

Fig. 1A

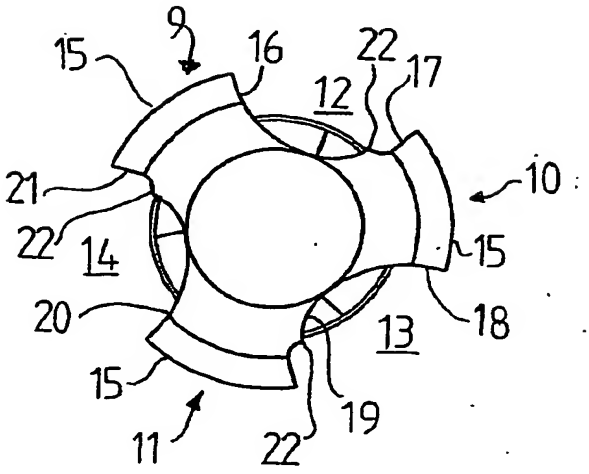

Fig. 1B

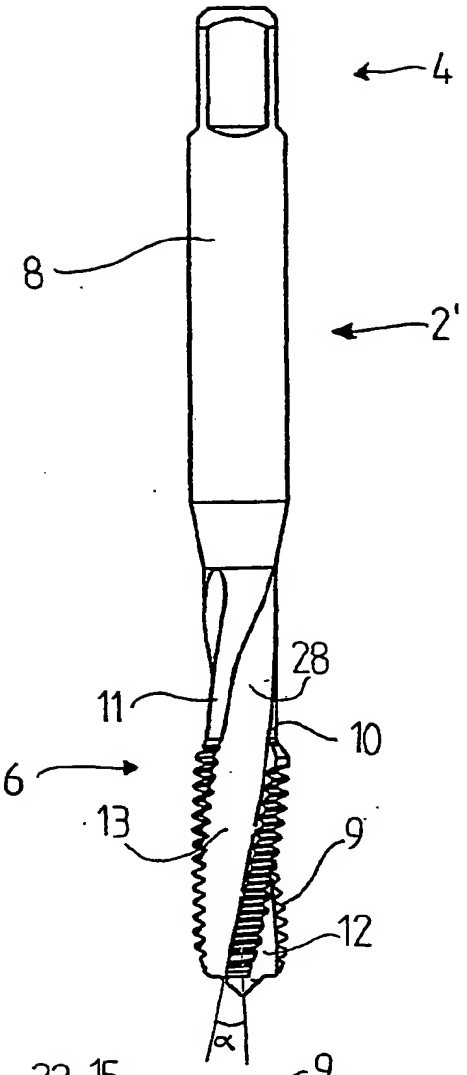

Fig. 2A

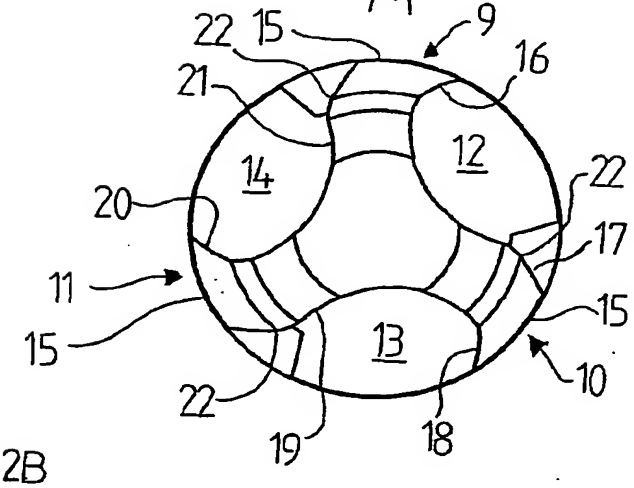

Fig. 2B

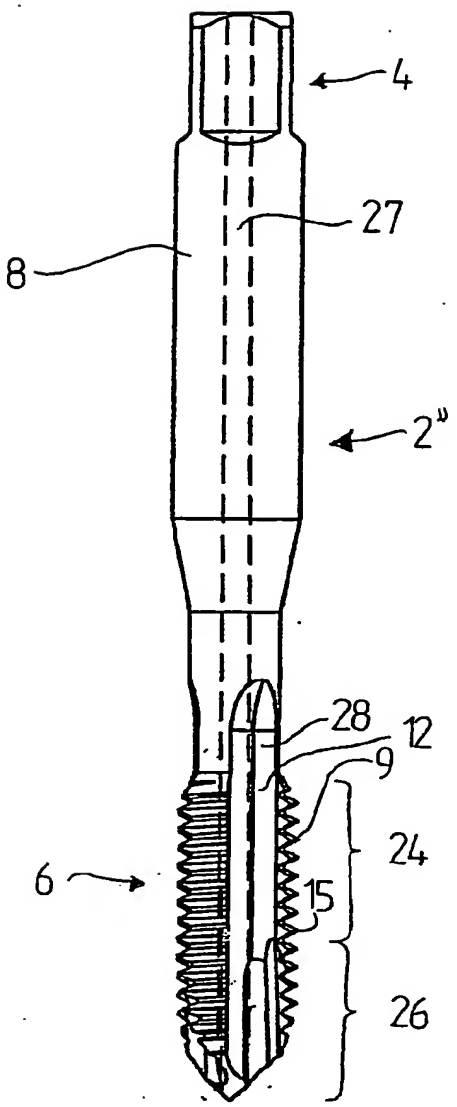

Fig. 3A

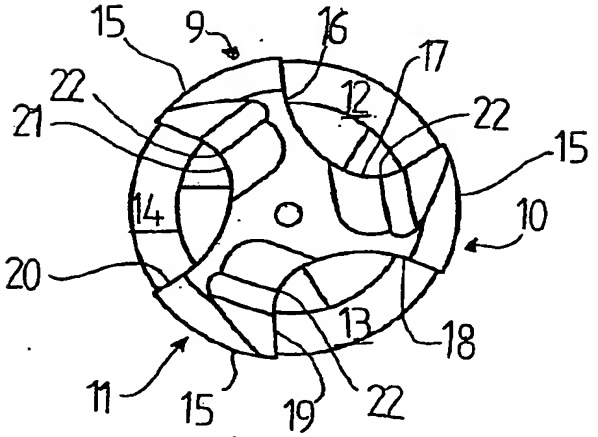

Fig 3B

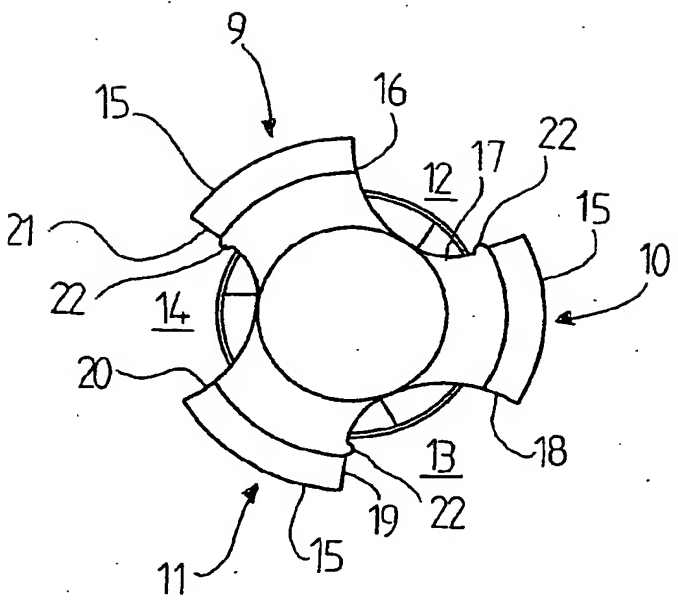

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/00837

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B23G 5/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0122176 A2 (TARAUDS COURCELLE-GAVELLE), 17 October 1984 (17.10.84), page 2, line 30 - line 35, figure 1, abstract --	1-24
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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Date of the actual completion of the international search	Date of mailing of the international search report
28 June 2002	25 -07- 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Lars Hennix/MP Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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10/06/02

International application No.
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